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10/529,238	03/25/2005	Takashi Arakane	OHTN:023	2552

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EXAMINER	
CROUSE, BRETT ALAN	
ART UNIT	PAPER NUMBER
1794	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/529,238	ARAKANE ET AL.	
	Examiner	Art Unit	
	Brett A. Crouse	1794	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 October 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5 and 8-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5 and 8-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *20091119;20091021*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 31 August 2009 and supplemental submission filed on 23 October 2009 has been entered.

Status of Claims

2. The amendment, filed 23 October 2009, amends claims 1, 2, 8, 11, 16, cancels claims 6, 7, and adds new claims 17, 18.

3. Claims 1-5 and 8-18 are pending.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 1-5 and 8-18 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for the exemplified compounds, does not reasonably provide enablement for the full scope of the claims. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the invention commensurate in scope with these claims.

Case law holds that applicant's specification must be "commensurately enabling [regarding the scope of the claims]" *Ex Parte Kung*, 17 USPQ2d 1545, 1547 (Bd. Pat. App. Inter. 1990). Otherwise **undue experimentation** would be involved in determining how to practice and use applicant's invention. The test for undue experimentation as to whether or not all compounds within the scope of claims 1-5 and 8-18 can be used as claimed and whether claims 1-20 meet the test is stated in *Ex parte Forman*, 230 USPQ 546, 547 (Bd. Pat. App. Inter. 1986) and *In re Wands*, 8 USPQ2d 1400, 1404 (Fed.Cir. 1988). Upon applying this test to claims 1-5 and 8-18, it is believed that undue experimentation **would** be required because:

(a) *The quantity of experimentation necessary* is **great** since claims 1-5 and 8-18 read on an enormous number of potential compounds, based on experimentally determined properties while the specification discloses a relatively small number of structurally similar compounds which **may** meet the requirements of the physical properties.

(b) There is **no** *direction or guidance presented* for determining in advance which compounds might meet the numerous requirements, short of separately testing every material.

(c) There is an ***absence*** *of working examples* within the scope of the claims. The few inventive examples disclose only closely related inventive compounds for the compound of the light emitting layer.

In light of the above factors, it is seen that undue experimentation would be necessary to make and use the invention of claims 1-5 and 8-18.

The materials required by claim 1 are:

a) A light emitting layer of an electroluminescent device comprising a host material having an ionization potential of less 5.9 eV and an electron mobility of 10^{-5} cm^2/Vs or greater, and a phosphorescent dopant. CBP is excluded as the host material.

b) The adjacent layer in contact with the light emitting layer and between the light emitting layer and cathode comprises a material having an energy gap smaller than that of the host material of the light emitting layer.

No guidance is given outside the closely related exemplified compounds as to the effect of the combinations of the large number of possible substituents of the broad general formulae and their effect on the ionization potential and electron mobility of the resulting compounds.

No guidance is given as to the selection of the vast number of materials outside of the general formulae as to the expected properties opposite the instant claims, short of separately testing every material.

The requirements for each of the materials are not defined, except by physical properties. The claimed compounds are materials having a particular oxidation potential and electron

mobility or energy gap. The oxidation potential, electron mobility and energy gap can be experimentally determined. The methods and results can vary depending on experimental procedures. As a result, each potential compound (essentially every known, and unknown material) must be individually tested to determine if the material and subsequently combination of materials meets the qualifications for the layers of the device. As a result, an individual of ordinary skill must resort to trial and error in order to determine which materials are suitable, which is well beyond the level of undue experimentation.

7. Claims 1-5 and 8-18 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims merely setting forth physical characteristics desired in an article, and not setting forth specific compositions which would meet such characteristics are invalid as vague, indefinite, and functional, since they cover any conceivable combination of ingredients either presently existing or which might be discovered in the future and which would impart desired characteristics. *Ex Parte Slob*, 157 USPQ 172 (1967).

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 1, 2, 3, 4, 6, 7, 8, 9, 10, 14, 15, 16, 17, 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shirasaki et al., US 5,834,894, in view of Okada et al., US 2002/055014, with further evidence provided by Matsushima et al., Current Applied Physics, (2005), Volume 5, Pages 305-308, and Bernede et al., SCELL-2004 International Conference on Physics, Chemistry and Engineering of Solar Cells, Badajoz, Espagne(13/05/2004), (2005), Volume 87, Number 1-4, Pages 261-270, (Abstract) and Wu et al., Advanced Materials, (2008), Volume 20, Pages 2359-2364.

Shirasaki teaches:

As to claims 1, 2, 4, 6, 8, 9, 10, 16, 17:

Column 7, lines 53-58, figure 9, teach an electroluminescent device comprising a hole transport layer, light emitting layer and electron transport layer directly upon the light emitting layer.

Column 11, lines 57-65, figure 19, teach an electroluminescent device comprising a hole transport layer, a light emitting layer which further comprises poly(vinylcarbazole) and a fluorescent dopant, and an electron transport layer directly upon the light emitting layer comprising Alq3.

As to claim 3:

Column 12, lines 5-58, teach a conductive layer which is liable to be oxidized, (a reductive material), between the electron transport layer and cathode.

Shirasaki does not recite:

Shirasaki does not recite a phosphorescent light emitting dopant. Shirasaki also does not recite materials other than PVK as a host material.

Instant Specification as evidence:

Table 1, page 88, teach the properties of Alq. One of ordinary skill in the art would expect the Alq3 used by Shirasaki to also possess such properties.

Wu et al., as evidence:

Page 2359, column 1, teaches the triplet energy of poly(vinylcarbazole) (PVK) is 2.5 eV.

Bernede et al., Scell-2004 (Abstract) as evidence:

Scell-2004 (Abstract), teaches the HOMO and LUMO of poly(vinylcarbazole) (PVK) are 5.7 eV and 2.2 eV respectively.

Matsushima et al., as evidence:

Matsushima, page 307, column 2, paragraph 1, and figure 6, teaches CBP electron mobility of 10^{-4} cm^2/Vs.

Okada teaches:

Paragraphs [0236]-[0238], example 1, table 1, teaches electroluminescent devices comprising a light emitting layer having the compositions shown in table 1 and an Alq_3 electron transport layer deposited thereupon. Compositions of the light emitting layer include CBP, devices 101 and 102, as host and a phosphorescent light emitting material, K-1 and K-6, the structures of which are shown in paragraph [0214]. The properties of CBP and Alq are taught in Table 1, page 88, of the instant specification.

Paragraphs [0244]-[0246], example 3, table 3, teach electroluminescent device 301, comprising a hole transport layer, a light emitting layer which further comprises poly(vinylcarbazole) and a phosphorescent dopant K-1, $(Ir(ppy)_3)$. The passage also teaches the use of compound 63 as the host material, an imidazopyridine. It is noted that compound 3 also provides a benzimidazole. The exemplified materials contain numerous compounds comprising a carbazole group bonded via an arylene group to a benzimidazole/imidazopyridine group. Pages 12-13 of the instant specification describe as formula (I) with n=1 a carbazole bonded via an arylene group to a benzimidazole/imidazopyridine group as preferred groups. The instant specification also teaches the ionization potential of 5.6 eV to 5.8 eV. Given this teaching of the preferred groups of the instant specification opposite the structure of compound 63, in the absence of unexpected results the compound would be expected to possess the properties as per the limitations of instant claims 1, 2, 7, 16, 17.

Paragraphs [0054], [0067], formula (A-II), provide examples of the linking group (L) of formula (A-II). Exemplified groups include pyridine.

Paragraphs [0217] and [0227]-[0232], teach a hole transport layer, electron transport layer and electron injection layer. The passage additionally teaches the functions of hole blocking and electron blocking are optional.

Paragraph [0004], teaches phosphorescent dopants, such as $Ir(ppy)_3$, provide improved quantum efficiency.

Paragraphs [0206]-[0214], teach preferred phosphorescent compounds. Paragraph [0213], teaches K-1, $(Ir(ppy)_3)$, and complexes having the partial structure thereof are preferred.

Statement of Obviousness:

It would have been obvious to one of ordinary skill in the art to use the phosphorescent dopants of Okada in the device of Shirasaki to realize the improved efficiency as suggested by Okada. It would have been obvious to use the materials of Okada such as compound 63, as the host material in the device of Shirasaki to realize the improved performance when used to replace PVK as taught by Okada. It would have been obvious given the teachings of the material properties of the supporting references to expect the resulting device to possess the interrelationship of properties between the layers as contemplated by applicant.

10. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shirasaki et al., US 5,834,894, in view of Okada et al., US 2002/055014, with further evidence provided by Matsushima et al., Current Applied Physics, (2005), Volume 5, Pages 305-308, and Bernede et al., SCELL-2004 International Conference on Physics, Chemistry and Engineering of Solar Cells, Badajoz, Espagne(13/05/2004), (2005), Volume 87, Number 1-4, Pages 261-270, (Abstract) and Wu et al., Advanced Materials, (2008), Volume 20, Pages 2359-2364, as applied to claims 1, 2, 3, 4, 6, 7, 8, 9, 10, 14, 15, 16, 17, 18 above, and further in view of Adachi et al., Organic Electronics, (2001), Volume 2, Pages 37-43.

The teachings of Shirasaki as in the rejection above are relied upon.

Shirasaki does not teach:

Shirasaki does not teach a relationship between the triplet energy level of the hole transport layer material and the triplet energy levels of the phosphorescent dopant of the light emitting layer.

Adachi teaches:

Pages 40-41, teach energy is transferred from the MTDATA hole transport layer material into the $Ir(ppy)_3$ dopant in the adjacent light emitting layer. The triplet energy of MTDATA is greater than the triplet energy of $Ir(ppy)_3$ resulting in improved device performance by improved triplet exciton confinement.

Statement of Obviousness:

It would have been obvious to one of ordinary skill in the art to select a hole transport material having a triplet energy greater than that of the phosphorescent dopant in the adjacent light emitting layer of the device of Shirasaki in order to improve device performance by improving exciton confinement as suggested by Adachi.

11. Claims 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shirasaki et al., US 5,834,894, in view of Okada et al., US 2002/055014, with further evidence provided by Matsushima et al., Current Applied Physics, (2005), Volume 5, Pages 305-308, and Bernede et al., SCELL-2004 International Conference on Physics, Chemistry and Engineering of Solar Cells, Badajoz, Espagne(13/05/2004), (2005), Volume 87, Number 1-4, Pages 261-270, (Abstract) and Wu et al., Advanced Materials, (2008), Volume 20, Pages 2359-2364, as applied to claims 1, 2, 3, 4, 6, 8, 9, 10, 16, 17, 18 above, and further in view of Okada 6,656,612.

The teachings of Shirasaki / Okada ‘014 as in the rejection above are relied upon.

Shirasaki / Okada ‘014 does not recite:

Shirasaki / Okada ‘014 does not provide an example of an electron transport layer in which an exemplified compound of formula 1 Okada ‘014 is used. Okada ‘014 does teach various heterocyclic derivatives are useful as electron transport materials including Alq as used in Shirasaki.

Okada ‘612 teaches:

Column 2, line 34 through column 6, line 4, formulae (I – XI), teach nitrogen containing heterocyclic compounds useful in electroluminescent devices.

Column 6, lines 33-51, provide examples of condensed rings of the various formulae.

Columns 8 through 12, teach various linking groups including naphthalene and anthracene as required by claim 12.

Column 93, lines 45-63, examples 5 and 6, teach exemplified compounds 21 and 18 in the electron transport layer. The compounds meet the limitations of claims 11 and 13.

Statement of Obviousness:

It would have been obvious to one of ordinary skill in the art to use the compounds of Okada '612 in the electron transport layer of the device of Shirasaki / Okada '014 with the expectation that the resulting layer of the device of Shirasaki / Okada '612 would exhibit suitable properties and efficient device operation as observed in Okada ‘612.

12. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fujino et al., JP 2000-169448, in view of Okada et al., US 2002/055014, as evidenced by Tanaka et al., Japan Journal of Applied Physics, (2003), Volume 42, Pages 2737-2740.

Fujino teaches:

Abstract and paragraph [0001], teach compounds of formula (I) as charge transfer or light emitting materials. The passage additionally teaches the compounds of formula (I) are useful in electroluminescent devices.

Paragraphs [0032], [0033], [0038], [0039], [0040], compounds (5), (10), (11), (39), (45), (51), teach compounds of formula (I) comprising one or more carbazole groups linked to a pyridine ring via an arylene group. In the absence of unexpected results the compounds are expected to possess properties meeting the host material limitations due to their close similarity in structure to exemplified structure PB-102 of the instant invention.

Paragraphs [0082]-[0083], teach a luminescent dopant added to the light emitting layer.

Paragraphs [0069]-[0072], drawings 1-4, teach electroluminescent device structures.

Paragraph [0118], teaches OXD-7 as the electron transport material in an electroluminescent device example.

Tanaka as evidence:

Page 2739, column 1, lines 27-29, teach the triplet energy of OXD-7 is 2.7 eV.

Fujino does not teach:

Fujino does not teach the use of a phosphorescent dopant in the light emitting layer.

Okada teaches:

Paragraph [0004], teaches phosphorescent dopants, such as $Ir(ppy)_3$, provide improved quantum efficiency.

Paragraphs [0206]-[0214], teach preferred phosphorescent compounds. Paragraph [0213], teaches $Ir(ppy)_3$, K-1 and complexes having the partial structure thereof are preferred.

Statement of Obviousness:

It would have been obvious to one of ordinary skill in the art to use a phosphorescent dopant of Okada, such as preferred compound $Ir(ppy)_3$, in the device of Fujino in order to achieve improved quantum efficiency in the device of Fujino.

Response to Arguments

13. Applicant's arguments have been fully considered but they are not persuasive.

With respect to the rejection over Shirasaki et al. in view of Okada et al., with further evidence provided by Matsushimi et al., Bernede et al., and Wu et al. applicants argue:

1. It would not be obvious to replace a fluorescent dopant with a phosphorescent dopant.
2. The exclusion of a hole blocking layer in a phosphorescent electroluminescent device is not obvious over Shirasaki and Okada.
3. Neither Shirasaki not Okada requires the host material to have an ionization potential of 5.9 eV or less and an electron mobility of 10^{-5} cm^2/Vs or greater.
4. The instant invention provides unexpected results and solves a problem that is a long felt need in the industry.

5. Claim 2 is further patentable because it recites a triplet energy of the material of the electron transport/injection layer that is smaller than that of the host of the light emitting layer.

6. Claim 18 is further patentable because Shirasaki and Okada alone or in combination do not teach or suggest pyridine or pyrimidine groups in combination with a carbazole group.

The examiner respectfully disagrees for the reasons below.

As to point 1:

It is well known in the prior art that triplet (phosphorescent) emission offers improved quantum efficiency over singlet (fluorescent) emission. Okada teaches such an improvement and teaches material combinations of phosphorescent materials in polyvinylcarbazole and host materials that offer improved performance over polyvinylcarbazole as host material.

As to point 2:

The teachings of Okada are broader that the example cited by applicant. The disclosure of Okada does not require a hole blocking layer in the device and additionally provides experimental examples including polyvinylcarbazole and a phosphorescent dopant in a device in which no hole blocking layer is provided.

As to points 3 and 5:

Okada has constructed in the examples a functional device comprising compound 63 and a phosphorescent dopant and suggested this combination as an improvement over polyvinylcarbazole. As per applicants specification compound 63 would be expected to

inherently possess the ionization potential, electron mobility and triplet energy as claimed in the instant claims.

As to point 4:

Applicant's argument of unexpected results is not commensurate in scope with the scope of the claims. The instant claims are not limited in scope to the breadth of the materials for which experimental data is presented in an attempt to establish unexpected results.

As to point 6:

Okada teaches pyridine as a suitable linking group (L) for compounds of formula (A-II).

Miscellaneous

Please note applicant's remarks indicate the rejection is Shirasaki in view of Okada and further in view of Matsushimi et al., Bernede et al., and Wu et al.

Matsushimi et al., Bernede et al., and Wu et al. are references used only as additional evidence and are not directly relied upon in the rejection.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brett A. Crouse whose telephone number is (571)-272-6494. The examiner can normally be reached on Monday - Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, D. Lawrence Tarazano can be reached on 571-272-1515. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/B. A. C./
Examiner, Art Unit 1794

/D. Lawrence Tarazano/
Supervisory Patent Examiner, Art Unit 1794